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ME-7164
Vol 5 of 5

# INSTRUCTION MANUAL

# MS-2

# UHF PULSE SOURCE

*High Speed Digital Instrumentation*

tau-tron

ME-7166
Vol 5 of 5

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## MS-2

## UHF PULSE SOURCE

*High-Speed Digital Instrumentation*

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## INTRODUCTION

The Tau-Tron Model MS-2 UHF Pulse Source provides stable, digital clock pulses, adjustable from 1 Hz to 300 MHz, for general-purpose system timing. With its array of features, the MS-2 offers versatility as a basic clock source in the Tau-Tron Modular Instrument series.

Two output frequencies are provided: FO, The VCO output, variable from 100 MHz to 300 MHz; and FN, a digitally selected division of FO, variable from 1 Hz to 100 MHz. Dual output connectors are available for both the FO FUNDAMENTAL and the FN FREQUENCY RANGE.

The MS-2 operates in three modes. In the internal (INT) mode, the MS-2 uses its own VCO as a frequency source; the FO and FN frequencies are selected by four controls.

In the external (EXT) mode an externally applied signal is accurately divided down by the FN Range Switches and available at the FN outputs.

In the cyrstal (XTAL) mode (optional), the frequency source is an internal crystal oscillator.

In addition to these modes, a gate input is provided to control the FN outputs.

# SPECIFICATIONS

FREQUENCY

Internal (FN)---1 Hz to 100 MHz. Sub-frequency selection of FO in three ranges and up to six sub-multiple steps each.

Internal (FO)---100 MHz to 300 MHz, in two ranges.

External---1 Hz to 100 MHz.

XTAL (Option)---100 MHz maximum.

EXTERNAL IN

One volt p/p minimum amplitude, 5 ns width minimum. 50 ohm input impedance. 5 volt p/p maximum amplitude; maximum +3v pulse top.

GATE INPUT

Standard levels. 50 ohm input impedance. Minimum width 5 ±1 ns.

OUTPUT

FO Output---2 BNC connectors. 1.5 volts min.from 100 - 200 MHz. 1.0 volts min. from 200 - 300 MHz.

FN Output---2 BNC connectors. Standard output. Width 50% of selected period, except 33% pulse width for the 10-30 MHz and 30-100 MHz ranges.

OPTION

Crystal Frequency.

STANDARD TMI SIGNALS

Logical Zero---Between -200 mv and +600 mv.

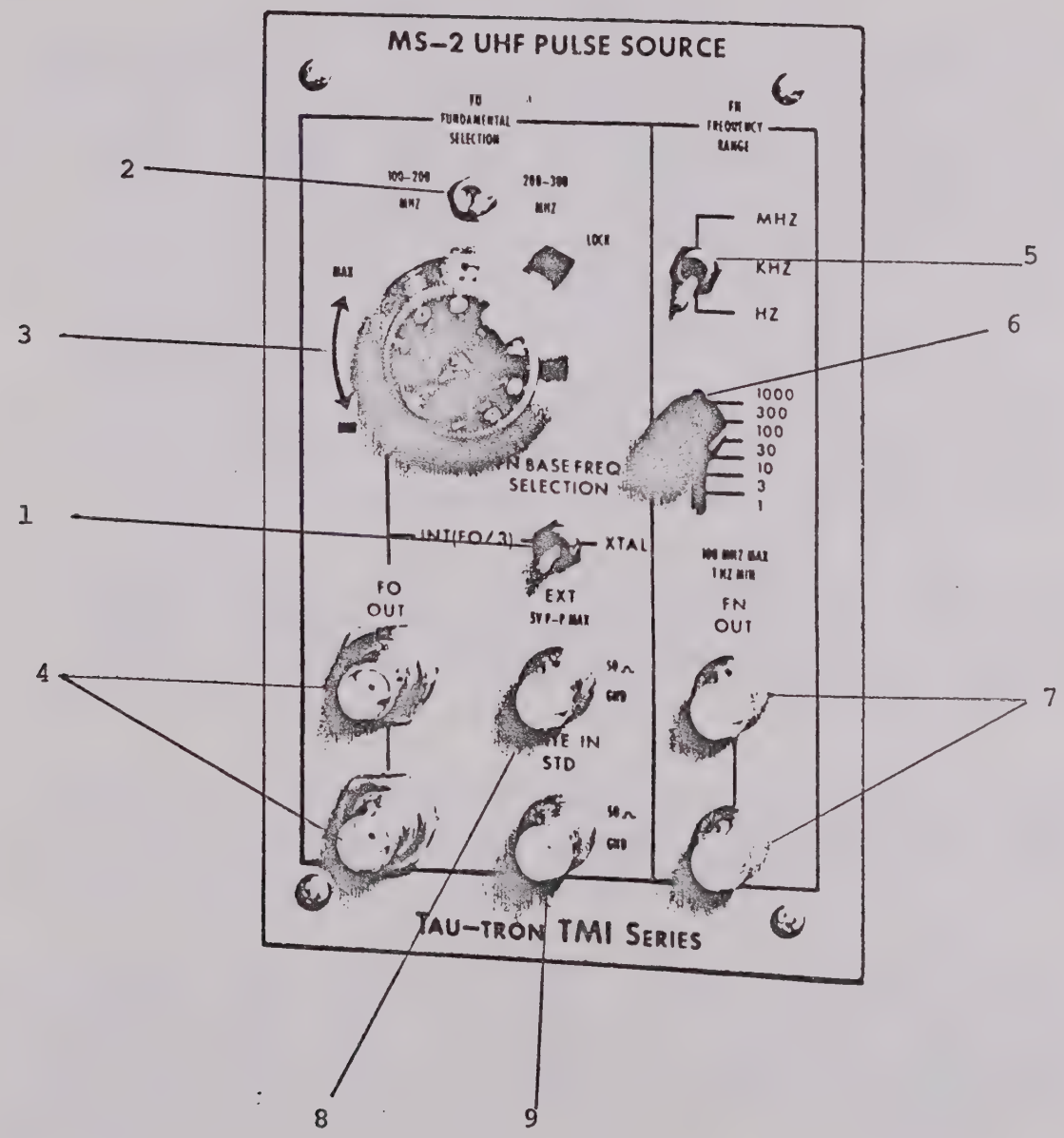
Logical One---More positive than 1.7 volts.

Standard Amplitude---2.0 volts typical.

Transition Edges---Typically 2 ns, 3.5 ns maximum.

Impedance---50 ohms to system ground.

Waveshape Distortion---Less than ±7%, terminated.


MS–2 UHF PULSE SOURCE
FO
FUNDAMENTAL
SELECTION
FN
FREQUENCY
RANGE
100–200
MHZ
200–300
MHZ
LOCK
MAX
MHZ
KHZ
HZ
1000
300
100
30
10
3
1
BASE FREQ
SELECTION
INT(FO/3)
XTAL
FO
OUT
EXT
FN
OUT
STD
TAU–TRON TMI SERIES
1
2
3
4
5
6
7
8
9

# OPERATING INSTRUCTIONS

## Front Panel Controls

1. Source Selection Switch---Any of three frequency source modes may be selected for the FN Base frequency:
   a. Internal (INT)---When the INT (FO/3) mode is selected, the MS-2 uses its internal voltage controlled oscillator (VCO), divided by 3, as the FN Base Frequency. FN output frequencies, from 1 Hz to 100 MHz, may be selected by adjusting the FN FREQUENCY RANGE switches in combination with the FO FUNDAMENTAL controls.
   b. External (EXT)---The EXT position enables the external input. A clock signal applied to EXT IN is the FN Base Frequency. A selected division of the input frequency appears at the FN outputs.
   c. Crystal (XTAL)---When the MS-2 is equipped with the optional crystal, the XTAL position engages the internal crystal as the FN Base Frequency. A selected division of the crystal frequency is present at FN.

2. FO Range---The FO FUNDAMENTAL Frequency range is selected by a front panel toggle switch that provides a FO output in either a 100-200 MHz range or a 200-300 MHz range.

3. FO Vernier---This ten-turn vernier control dial ensures precise selection of frequency. The dial locks to prevent any accidental frequency change. The FO outputs will always be between 100 MHz and 300 MHz; they will not be affected by the FN FREQUENCY RANGE switches.

4. FO Outputs---The dual FO outputs are at standard TMI signal levels. FO is 100 MHz to 300 MHz, continuously variable in two ranges. The FO outputs provide 1.5 to 3 ns pulses and must be terminated in 50 ohms to ground. FO outputs are the VCO regardless of the FN Base Frequency selected. An unused output should still be terminated by 50 ohms to ground for proper waveshape on the used output.

5. FN Frequency Scale Switch---This toggle switch designates the frequency scale - Hz, KHz, MHz - to be used with the Frequency Range (slide) switch.

6. FN Frequency Range Switch---This six position slide switch is used with the FN Frequency Scale Switch to accurately divide down the FO Frequency in all three operating modes. In the INT (FO/3) mode, each detent specifies a continuous frequency range; fine adjustment is made by rotating the FO vernier control dial while monitoring the FN outputs. Together, these ranges form a total frequency range from 1 Hz to 100 MHz. In the external (EXT) and crystal (XTAL) modes, the vernier control dial does not affect FN, the FN Frequency Range switches together function as a discrete frequency divider. See Table 1.

7. FN Outputs---The dual FN outputs are at standard TMI signal levels. The FN output is a squarewave and must be terminated in 50 ohms to ground. An unused output must still be terminated by 50 ohms to ground for proper signal waveform on the used output.

8. External Clock Input---This BNC input, 50 ohms to ground, will accept a 5v p/p maximum amplitude, +3v maximum pulse top input. It gives the user the ability to accurately divide an input clock frequency; the divided output will appear at FN OUT.

9. Gate Input---This BNC input, accepting standard TMI signals, allows the user to gate the FN outputs on and off, in all three modes of operation. The gating is synchronous with the FN Base Frequency selected. This input is 50 ohms to ground.

## TABLE 1

### FN FREQUENCY SELECTION

| | MHz | kHz | Hz |
|---|---|---|---|
| 300 to 1,000 | No Output | $\frac{FB}{10^2}$ | $\frac{FB}{10^5}$ |
| 100 to 300 | No Output | $\frac{FB}{3 \times 10^2}$ | $\frac{FB}{3 \times 10^5}$ |
| 30 to 100 | FB | $\frac{FB}{10^3}$ | $\frac{FB}{10^6}$ |
| 10 to 30 | $\frac{FB}{3}$ | $\frac{FB}{3 \times 10^3}$ | $\frac{FB}{3 \times 10^6}$ |
| 3 to 10 | $\frac{FB}{10}$ | $\frac{FB}{10^4}$ | $\frac{FB}{10^7}$ |
| 1 to 3 | $\frac{FB}{3 \times 10}$ | $\frac{FB}{3 \times 10^4}$ | $\frac{FB}{3 \times 10^7}$ |

FB is the FN Base Frequency: either INT (FO/3), or EXT, or XTAL.

## TIMING CONSIDERATIONS

### INPUTS

Both inputs are asynchronous to the internal logic, and may be applied at any time. EXT will become the clock source (FN Base Frequency) for the FN divider logic, and is therefore "self-synchronizing". GATE IN will be synchronized internally to the selected FN Base Frequency. There will be an ambiguity of one period of the FN Base Frequency from application (or removal) of the GATE IN signal, and its effect upon the FN output.

### OUTPUTS

Both FO outputs are typically edge aligned. Both FN outputs are typically edge aligned.

## THEORY OF OPERATION

The Tau-Tron Model MS-2 UHF Signal Source can provide a clock signal for equipment operating from less than 1 Hz to 300 MHz. This is accomplished by providing two simultaneous output frequencies: the fundamental VCO output (FO) covers the 100 MHz to 300 MHz band, and the sub-multiple output (FN) covers the frequencies up to 100 MHz.

### FO Voltage Controlled Oscillator

The UHF VCO is located on a separate PC board from the FN frequency division logic. It actually consists of two VCO's due to the very wide bandwidth required. Only one VCO is powered at any time via a front panel FO range selection. Both VCO's are identical except for the tank circuit components: one covers the range from 100 MHz to 200 MHz, the other covers the range from 200 MHz to 300 MHz. A front panel ten-turn potentiometer provides precise adjustment of the control voltage over the frequency range selected.

The output of the selected VCO is amplified on the UHF board to provide essentially fixed width pulse outputs (two) driving a 50 ohm external load. Typical pulse width is 1.5 ns at 300 MHz to 3.0 ns at 100 MHz. A divide-by-3 logic circuit prescales the 100 MHz to 300 MHz frequency range of the UHF oscillator down to 33 MHz to 100 MHz for compatibility with the FN frequency division logic.

### FN Frequency Division Logic

The frequency source for the FN frequency division logic can be selected via front panel switch to be 1/3 the FO frequency, the optional crystal oscillator, or the external input. A divide-by 3 prescaler and seven decade stages comprise the digital frequency divider circuits. Either the selected frequency source, or the selected source prescaled by the divide-by-three logic is selected as the input to the decade divider chain.

The first decade stage is actually broken down into a divide-by-five and divide-by-two sections. The six remaining decades are driven from the divide-by-5 section, while the selected output stage always passes through the divide-by-2 section. This insures a squarewave output from the decade divider logic.

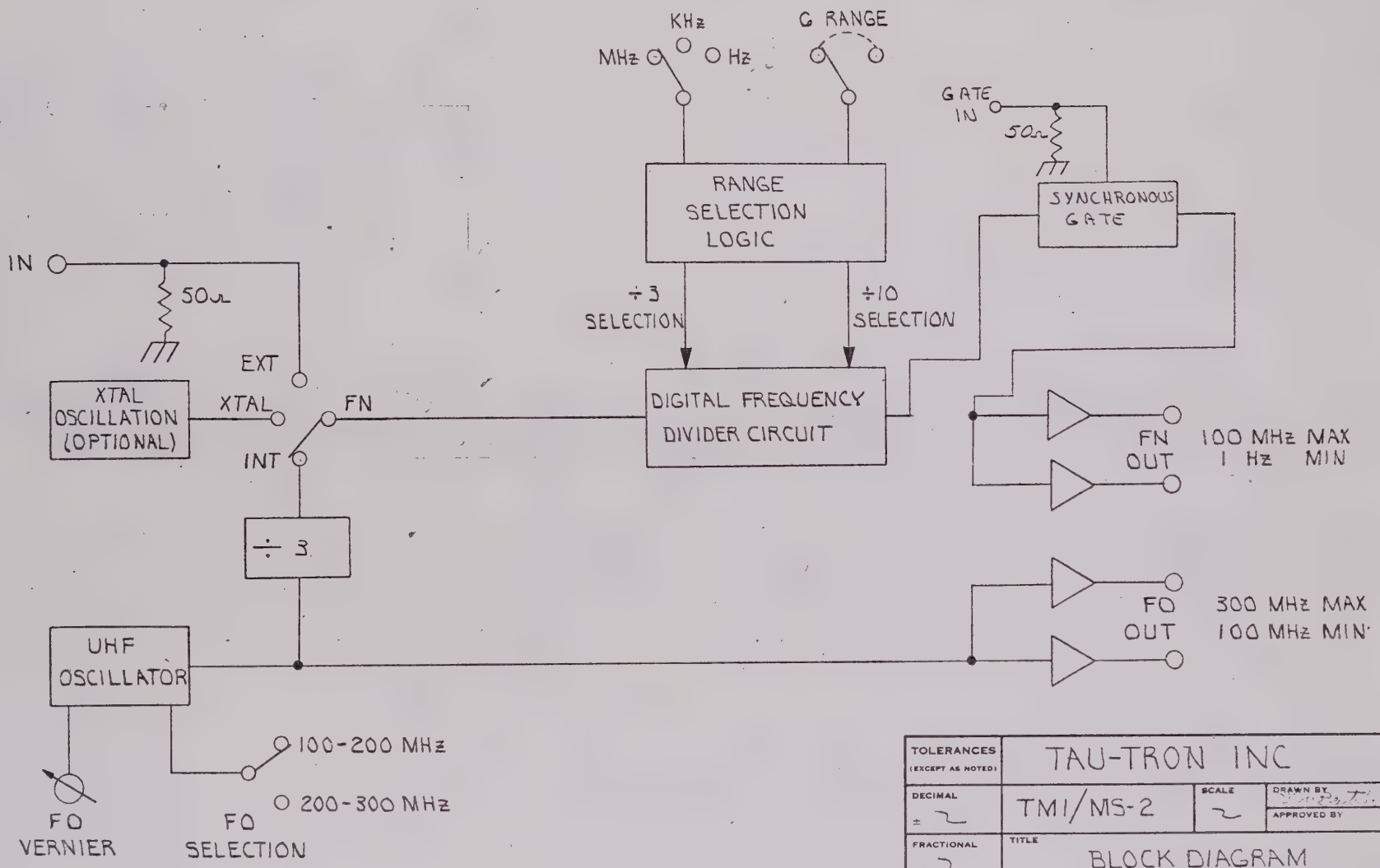
Selection of FN output frequency via the MHz/KHz/Hz range switch and the six-position 1-1000 range switch is decoded to select the decade divider input and the proper output stage for the desired FN frequency range. At the 10-30 MHz and 30-100 MHz selections, the decade divide input drives the output amplifier.

A gate input is provided to allow disabling of the output signal. It is synchronized by receiving the gate input into a latch clocked by the selected output frequency. This synchronizes the enabling/disabling of the output amplifier to the falling edge of the FN signal. When disabled, the FN outputs are forced to a low level.

## LIST OF ILLUSTRATIONS

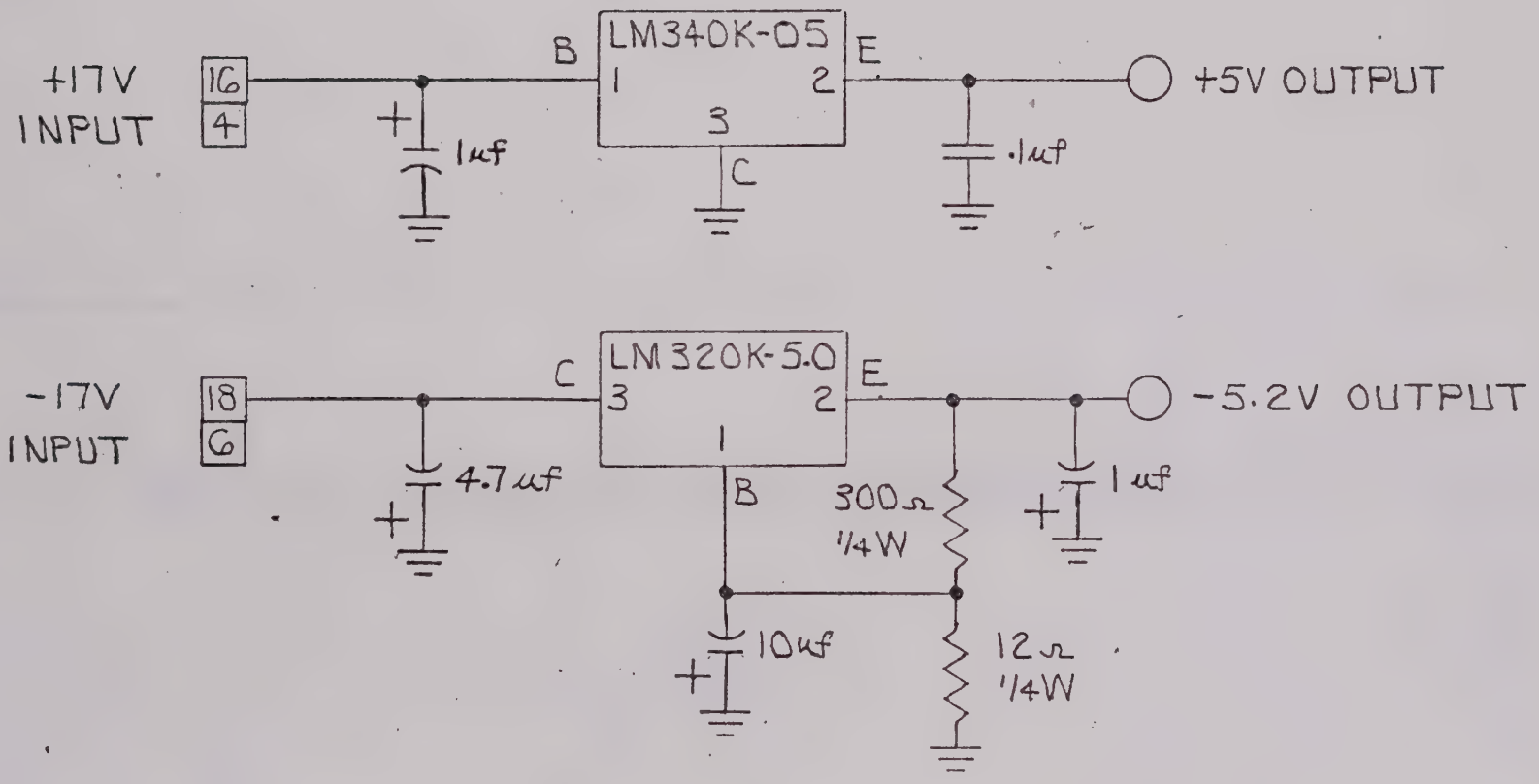
MS-2 Block Diagram. . . . . TBN-53348
Module Power Supply . . . . . TAJ-53382
UHF Oscillator Schematic. . . . . TCJ-53324
VHF Oscillator Schematic. . . . . TDJ-53922

| DATE | SYM | REVISION RECORD | DR | CK |
|---|---|---|---|---|
| 8-28-74 | 1 | DCR 74-00233 | | |



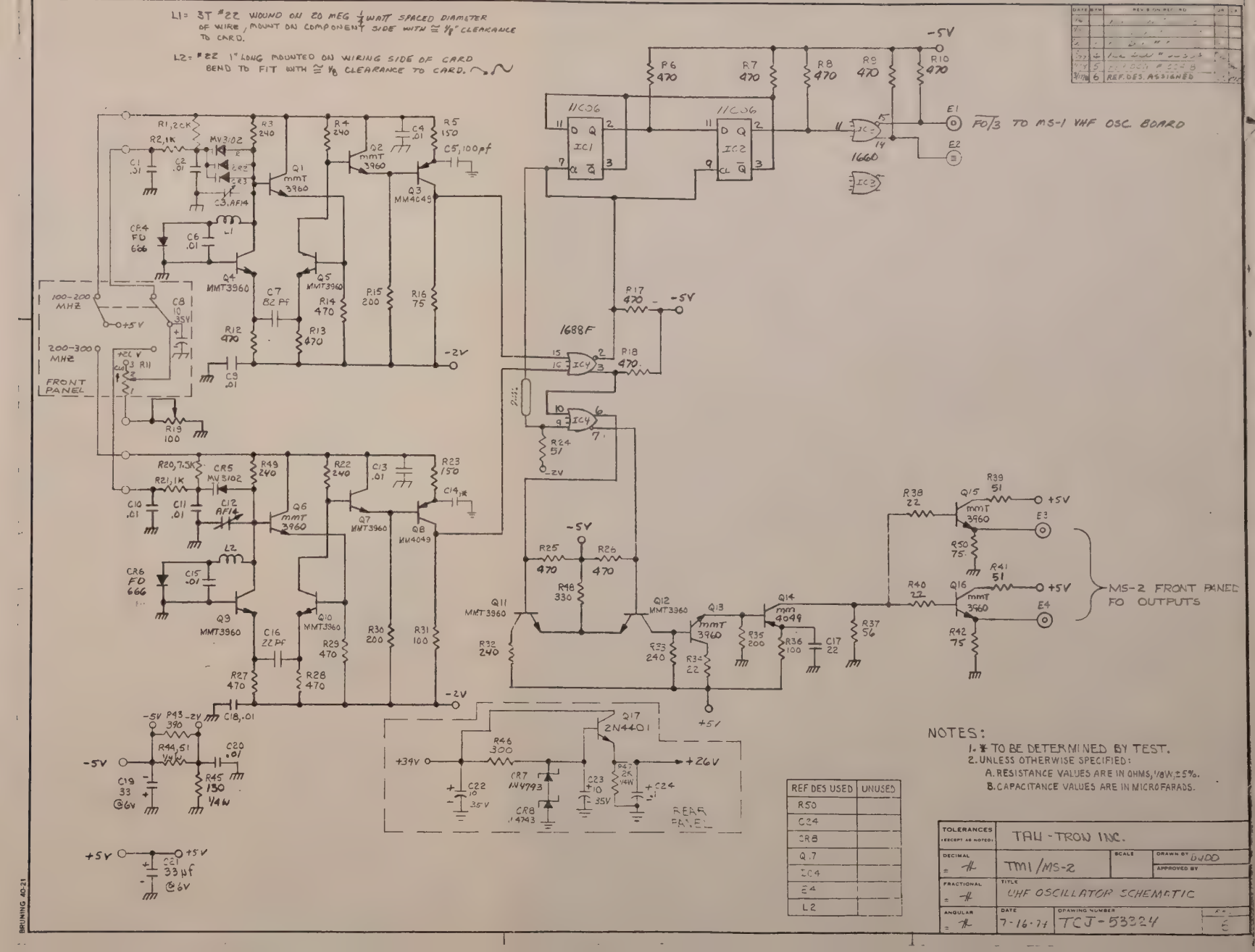

| | | | |
|---|---|---|---|
| TOLERANCES (EXCEPT AS NOTED) | TAU-TRON INC | | |
| DECIMAL ± | TMI/MS-2 | SCALE | DRAWN BY / APPROVED BY |
| FRACTIONAL ± | TITLE: BLOCK DIAGRAM | | |
| ANGULAR ± | DATE: 8-28-74 | DRAWING NUMBER: TBN-53348 | REV: 1 |

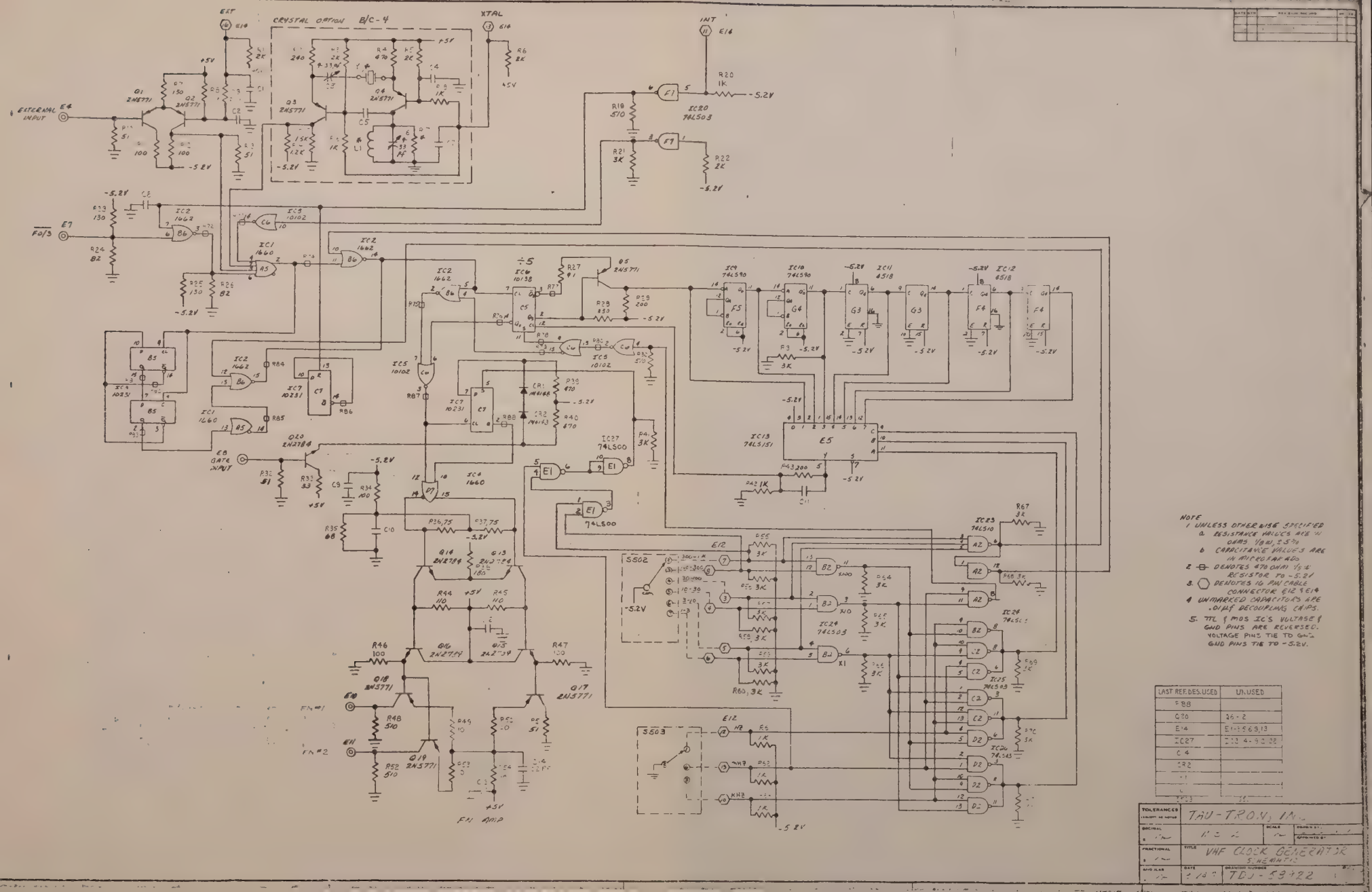
BRUNING 40-21




| | | | |
|---|---|---|---|
| TOLERANCES (EXCEPT AS NOTED) | TALI-TRON INC | | |
| DECIMAL ± ——— | TMI SERIES | SCALE ——— | DRAWN BY / APPROVED BY |
| FRACTIONAL ± ——— | TITLE SCHEMATIC MODULE POWER SUPPLY (±5V) | | |
| ANGULAR ± ——— | DATE 11/5/74 | DRAWING NUMBER TAJ-53382 | |

BRUNING 40-21


L1= 3T #22 WOUND ON 20 MEG ¼ WATT SPACED DIAMETER OF WIRE, MOUNT ON COMPONENT SIDE WITH ≅ 1/8" CLEARANCE TO CARD.
L2= #22 1" LONG MOUNTED ON WIRING SIDE OF CARD BEND TO FIT WITH ≅ 1/8 CLEARANCE TO CARD.
REV BLOCK
REF. DES. ASSIGNED
-5V
R6 470
R7 470
R8 470
R9 470
R10 470
11C06
IC1
IC2
IC3
1660
E1
FO/3 TO MS-1 VHF OSC. BOARD
E2
R1,2.2K
R2,1K
MV3102
C1 .01
C2 .01
C3, AFI4
R3 240
R4 240
Q1 mmt 3960
Q2 mmt 3960
C4 .01
R5 150
C5, 100pf
Q3 MM4049
CR4 FD 666
C6 .01
L1
Q4 MMT3960
Q5 MMT3960
C7 82 Pf
R14 470
R15 200
R16 75
R12 470
R13 470
C9 .01
-2V
100-200 MHZ
200-300 MHZ
+5V
FRONT PANEL
C8 10 35V
R11
R19 100
R17 470
1688F
IC4
R18 470.
R24 51
R20, 7.5K
R21, 1K
CR5
MV3102
R49 240
R22 240
C13 .01
R23 150
C14
C10 .01
C11 .01
C12 AFI4
Q6 mmt 3960
Q7 MMT3960
Q8 MM4049
L2
CR6 FD 666
C15 .01
Q9 MMT3960
C16 22 Pf
Q10 MMT3960
R30 200
R31 100
R29 470
R27 470
R28 470
C18, .01
R25 470
R26 470
R39 51
R38 22
Q15 mmt 3960
R50 75
R41 51
R40 22
Q16 mmt 3960
E3
E4
MS-2 FRONT PANEL FO OUTPUTS
R42 75
Q11 MMT3960
R32 240
Q12 MMT3960
R33 240
Q13 mmt 3960
R34 22
R35 200
Q14 mm 4049
R36 100
C17 22
R37 56
R48 330
-5V R43 390 -2V
R44, 51
C20 .01
C19 33 @6V
R45 130 1/4W
Q17 2N4401
+34V
R46 300
+26V
CR7 IN4793
CR8 IN4793
C22 10 35V
C23 10 35V
R47 2K 1/4W
C24
REAR PANEL
+5V
C21 33 µf @6V
NOTES:
1. * TO BE DETERMINED BY TEST.
2. UNLESS OTHERWISE SPECIFIED:
A. RESISTANCE VALUES ARE IN OHMS, 1/8W, ±5%.
B. CAPACITANCE VALUES ARE IN MICROFARADS.
REF DES USED
UNUSED
R50
C24
CR8
Q.7
IC4
E4
L2
TOLERANCES (EXCEPT AS NOTED)
DECIMAL ± .#
FRACTIONAL ± #
ANGULAR ± #
TAU-TRON INC.
TM1/MS-2
SCALE
DRAWN BY BJDD
APPROVED BY
TITLE
UHF OSCILLATOR SCHEMATIC
DATE 7-16-71
DRAWING NUMBER TCJ-53324
BRUNING 40-21




NOTE
1. UNLESS OTHERWISE SPECIFIED
   a. RESISTANCE VALUES ARE IN OHMS 1/4W, ±5%
   b. CAPACITANCE VALUES ARE IN MICROFARADS
2. ⊣⊢ DENOTES 470 OHM 1/2 W RESISTOR TO -5.2V
3. ⬡ DENOTES 16 PIN CABLE CONNECTOR E12 TO E14
4. UNMARKED CAPACITORS ARE .01μF DECOUPLING CHIPS.
5. TTL & MOS IC'S VOLTAGE & GND PINS ARE REVERSED. VOLTAGE PINS TIE TO GND. GND PINS TIE TO -5.2V.

| LAST REF.DES.USED | UNUSED |
|---|---|
| R88 | |
| Q20 | 16-2 |
| E14 | E1-5 6 9,13 |
| IC27 | 2,13 4-9,12,28 |
| C 4 | |
| CR2 | |
| R1 | |
| L | |
| F0/3 | 32 |

| | |
|---|---|
| TOLERANCES UNLESS NOTED | TAU-TRON, INC. |
| DECIMAL ± | SCALE |
| FRACTIONAL ± | TITLE VHF CLOCK GENERATOR SCHEMATIC |
| ANG ± | DATE 2/18/ DRAWING NUMBER TDI-53122 |

tau-tron
inc
27 Industrial Ave., Chelmsford, MA 01824
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# INSPECTION

## 1. MECHANICAL

If any damage is observed on the shipping carton, ask that the carrier's agent be present during unpacking. In the event that any external damage is found on the instrument, notify the carrier and Tau-Tron as soon as possible. Follow claims procedure below.

## 2. ELECTRICAL

Check out the electrical performance of the instrument as soon as possible after receipt. Should any malfunctions be observed, follow the claims procedure below.

## 3. CLAIMS

If the unit has mechanical damage or fails electrical check-out, notify Tau-Tron immediately. For mechanical damage which occurred during shipment, notify the carrier also. The Tau-Tron Customer Service Department will arrange for repair or replacement of the instrument. A Return Authorization number will be issued for all returns.

## 4. REPACKAGING

Use the original shipping carton and materials, if available. Otherwise use a double-walled carton (test strength of 350 pounds), and shock absorbing material such as bubble-wrap to prevent instrument from moving in the shipping carton during transit. Secure package by sealing with heavy paper tape.

NO. ME-7166 VOL 5

TITLE: MS-2
UHF PULSE SOURCE

| NAME/PHONE/ORGANIZATION | DATE |
| --- | --- |
| [redacted] | |
| [redacted] | |
| [redacted] | |
| [redacted] | |

27 Industrial Avenue, Chelmsford, MA 01824 (617) 25[illegible]013